

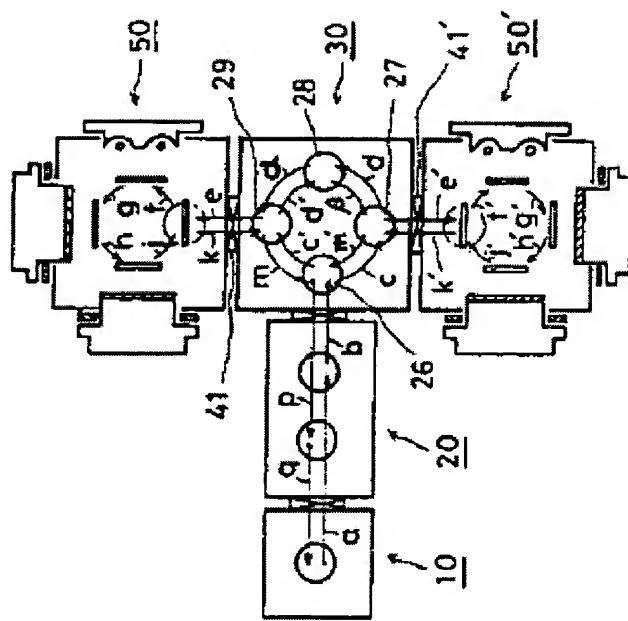
# VACUUM THIN FILM TREATING DEVICE

**Patent number:** JP60238479  
**Publication date:** 1985-11-27  
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**Classification:**  
- **international:** C23C14/56  
- **european:**  
**Application number:** JP19840093610 19840510  
**Priority number(s):**

## Abstract of JP60238479

**PURPOSE:** To improve remarkably the rate of operation of a thin film forming device by providing plural vacuum sputtering chambers for forming a thin film, and operating alternately the chambers in the thin film forming device by sputtering.

**CONSTITUTION:** When a metallic thin film or the thin film of an insulating material is formed on many substrates of plate-shaped silicon wafers, etc., the substrate is brought into a pretreating chamber 30 through a load lock chamber 10 and an intermediate storeroom 20, transported by stages 26, 27, and 29, heated and etched by a stage 28, then brought into sputtering chambers 50 and 50' which are separated by sluice valves 41 and 41', and sputtered in a vacuum. In this case, sputtering is carried out by using one of both sputtering chambers 50 and 50', and the other sputtering chamber is subjected alternately to periodical maintenance, a preliminary operation, etc. Since sputtering is carried out at all times alternately in one of the two sputtering chambers, the rate of operation with respect to the whole device can be remarkably improved.



④日本国特許庁 (JP)

①特許出願公開

②公開特許公報 (A) 昭60-238479

③Int.Cl.

C 23 C 14/56

識別記号

府内整理番号  
7537-4K

④公開 昭和60年(1985)11月27日

審査請求 未請求 発明の数 1 (全5頁)

⑤発明の名称 真空薄膜処理装置

⑥特 願 昭59-93610

⑦出 願 昭59(1984)5月10日

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明細書

1. 発明の名称

真空薄膜処理装置

2. 特許請求の範囲

(1) 装置を取扱し真空に排気することのできるロードロッカ室と、該装置に真空中で薄膜処理を施す処理室と、前記ロードロッカ室と該処理室の間にあって該装置を自動的に移動する機械をそれをかつて前記薄膜処理の前処理を行なうことができる。前処理室との三面からなる真空薄膜処理装置において、該処理室を設置組え、かつ該装置は該装置の処理室の中央から選ばれた少くとも一つの処理室で薄膜処理を行ない得るよう、ロードロッカ室と該装置の処理室の間に該装置の移動経路を選択できるよう構成したことを特徴とする真空薄膜処理装置。

3. 発明の詳細を説明

本発明はスパッタリングにより、同一形状の多数の板状基体に次々と自動的に薄膜を形成するスパッタ装置の構造に関するものである。更に具体

的には、本発明はスパッタ装置の保守に起因する装置のダウンタイムを短かくし、装置運転の全時間に占める正味の生産時間の比率を大きくとることのできるスパッタ装置の構造に関するものである。

本発明の具体的応用分野の一例は、無酸化ガス工程における薄膜作製過程である。そこで、例えば直径約125mm、厚み約0.5mm程度の円形荷板状シリコンウェーハの上に、厚さ約1ミクロン程度の金属薄膜や超薄膜を形成することが必要となる。作製すべき薄膜に必要なとされる電気的、機械的、物理的諸特性は、一般に真空容器内の不純物ガス分圧が低いほどすぐれたものが得られるので、スパッタリングにより薄膜作製を行う処理室は、可能な限り大気に近づく時間を短かくすることができる。また同じ目的から、処理室には不純物ガス発生の原因となる物体をできるだけ持込まないようにする必要があり、持込みはウェーハの移動に最低限必要な物体に限定することが望まれ、理想的には薄膜を作製すべし。

エーへだけを処理室に内込む構造の装置が望まれる。また大盤のウェーへに均質を部屋を既本良く作製するためには、ウェーへの操作はできる限り作業者が直接手を触れずに自動的に移送処理することが望ましい。更にまた、ウェーへ表面は所定の部分の部屋のみで被覆されことが必要であり装置を構成が嵌入したりあるいは膜の付着のないビンホール等の発生が防われる。そのため仮に医疾が生じても操作部屋中はその医疾がウェーへの投げに拘束しないよう、処理室内ではウェーへは無菌に保守されることが望ましい。

上述の如き目的に使用されるスペック装置の真空系は、基本的には、基体上に薄膜作業を行う処理室と、処理室の基体を大気中から投入しつつ処理室の基体を大気中へ搬送するロードロッカ室とで構成される。そして通常は、処理室はその不純物ガス分圧を出来るだけ低く保つため真空装置に保たれており、ロードロッカ室だけが基体の出し入れの都度大気に開放されかつ大気圧から真空に調節され、ロードロッカ室が真空になった状

態ではじめてロードロッカ室と処理室の間の仕切弁が開き、それぞれの容器の間を基体が移送されるようになっている。

ところで極めて大量のウェーへを長時間にわたり処理する生産工程を考えると、スペック装置を長日月に亘り運転して薄膜処理装置することは先づ常識的には考えられない。即ち、必ず何かの理由により装置を停止し、処理室の真空を破壊する必殺を生ずる。生産者にとって好ましくないことではあるが、避けられない装置の停止の理由と装置の機械が何らかの事故により発せなくなる場合をもげることができる。装置の信頼性を高める強々の努力により、その事故の発生の確率は実用上問題を生じない程度まで低減することはできているが、経済性などの理由からこれを完全になくすこととはできない。

一般的には、装置を最初の装置を最後を経て運転することが行なわれ、むしろ定期的に処理室の真空を破壊し積極的に保守作業を行なっている保守作業の内容としては、消耗した古いターゲット

ト材の新品との交換、クライオポンプの再生による排気能力の回復、密閉内に付着したスペック膜の除去、ウェーへ移動装置機能の再調整等が含まれる。保守作業後、真空処理室は閉じられ再び排気されるが、最初述べたように、所定の品質の薄膜を得るためにには処理室の不純物ガス分圧を充分低くすることが必须で、生産に入る前に充分を排氣、ペーパンク、ブリスマッタリングなど長時間の予備操作が行われなければならない。ウェーへ上に薄膜を行設する正味の生産時間と、それ以外の装置の運転時間、即ち事故により装置が停止した時間とこれを修復する時間とあらかじめ計画された定期的な保守作業の時間とその後の生産開始までの予備操作に対する時間の合計時間の割合は装置の構成と使用部品の信頼性、装置を運転した後保守作業を行う作業者の操作、作業の適否、熟練度、作業すべき時に要求される特性の難易の位置等、各種要因の影響を受ける。しかし如何なるスペック装置においても、保守作業とそれに続く生産再開のための予備操作の時間が全体の時間に

占める割合は相当大きい。例えば現在用いられている典型的なスペック装置では、約3.3時間かけて2,000枚のウェーへを処理すると、その都度処理室の真空を破壊し、ターゲット交換を含む保守作業を行うが、保守作業を含めて次の生産再開までに4時間以上を要している。また別のスペック装置では約100時間かけて5,600枚のウェーへの処理するとその都度次の生産までに約10時間の保守作業と予備操作を必要としている。

本発明の目的は上述の問題を解決するスペック装置を提供することである。即ち、スペック装置運転の全時間に占める正味の薄膜作業時間の割合を大きくできる新規の装置の提供を目的とするものである。

さて、その装置の概要を述べると、この不説明に示しては一つの真空薄膜処理装置の内部に同じ機能の薄膜処理室を複数個保有する。そして各室が独立に操作している間は、その中の第1の処理室で薄膜の処理が行なわれ、他の処理室は初期のためにには使用されない。次に所定の計算時間の計算

処理作業が終り、第1の処理室の処理を停止してその真空を取り戻すの保守作業に対する段階になると、荷葉処理をすべてを基体は搬送段階を変更して第2の処理室に取り込まれ、そこで処理が開始される。そして、第2の処理室で処理が行なわれるのに並行して、第1の処理室内では定期的保守作業が行われ、それに伴って処理を開始するための予備操作が行なわれる。この定期的保守作業と予備操作に費やされる時間は、一般に第1、第2の各処理室が運転作業に見える時間よりは長いので、第2の処理室がその処理を停止して保守すべき時期に達したときには既に第1の処理室では処理を再開できる状態になっている。かく、同じ機械をもつ第1の処理室と第2の処理室を交互に使用することにより、切れ目なく両機の処理を行なうことができる。また、この方式によれば予定していない事故が発生して処理室を修理せねばならぬ場合が生じた時にも、それの使用していかなかった処理室の方へ処理すべき荷葉を送り込み生産を継続しながら事故を修理することができる。

上述の説明では、第1、第3の2個の処理室を交互に使用する場合について述べた。一般には同じ機械の処理室が2個あれば運転して生産を行うのに実用上実際はない。しかし、もし同じ機械の処理室を3個以上設えれば、定期的保守作業及び予備操作のために費やす時間が比較的長い場合とか、不測の事故の発生頻度が高い場合には、生産を中断する危険性を極めて低くすることができます。しかし、装置全体としては占有空間の容積が大きくなり、かつ高価格になる。これらの点を踏ま合わせ考慮すると実用的には、2個の同じ機械をもつ処理室を設けて連続生産が可能となるよう装置が好ましい。しかし本発明は、同じ処理室の数について特に制約を加えるものではない。

次に図面により、更に具体的な説明をする。

第1図は、焚却方式のスパッタ装置の一例を示す。図において装置は、ロードロッタ室、基体の中間収納室20、前処理室30、及びスパッタ室50で構成され、各室の間に仕切弁21、31、41が設けられている。各部は図示されていないが

シップによりそれぞれ依次に排氣され真空に維持される。新しい荷葉はカセット12に取納されてロードロッタ室の入口11からロードロッタ室10に挿入され、また、スパッタリングにより該付処理が併んだ後に30から取出される。中間収納室20には二種のカセット22、23が設けられている。中間収納室20は、ロードロッタ室10の回転による前処理室30及びスパッタ室50の真空の質の劣化を防止すると共に、未処理荷葉と既処理荷葉の搬送が装置全体の時間通り処理能力を犠牲にせずに行なわれるようを目を保てており、その構成と役割に関する詳細な説明は、特願昭55-169057及び特願昭55-137802の中に与えられている。前処理室30はスパッタ動作時の前駆階で基体加熱あるいはスパッタエッテンク等の予備的処理を行う役割を果す。基体は、4個のステージ26、27、28、29のいずれかの上に配設させられる。このうちステージ27は加熱あるいはスパッタエッテンクに使用され、ステージ29は冷却羽に使用できる。ロードロッタ室10、中

間収納室20、及び前処理室30にかかる基体の搬送ベルトを使用した直線運動と適宜の曲を中心とする回転運動によって行なわれるが、それらについて特願昭55-151815、特願昭56-35743に詳細に説明されている。

スパッタ室50内では、水平状態の基体42(一点鎖錠)が、90°回転して43に示す如く段階駆動状態に保持され、次いで、その上にスパッタ室30のはじめ中心にある給直管301の周囲を約90°ステップで回転する。このスパッタ室30の第2のステージで基体44は加熱ランプ51、52により加熱され、第3のステージで基体45の上に該付処理がなされる。同様に第4のステージでも基体46の上に該付処理がなされる。第3及び第4のステージでは基体に對向する位置にスパッタ電極60、60'が設けられている。スパッタ電極はターダー61、カソードボディ62から成り、基体63を介して真空容器壁面に取付けられている。カソードボディ62にはスパッタ電極70より給電端子71、72を経由して(アース電

位に対して)次の高電圧が印加される。ただし金属製真空容器は、アース部S1でアースされアース選択にある。表示されていないガス導入系を経由して、スペック室50にアルゴン等のガスを供給すると、陰極近傍で低圧ガス放電が生じ陽イオンがターゲット61等を叩く結果、スペックリングによる荷重作成が行われる。装置全体の中でカセット12に収容された基体13は矢印aを経て、中間収納室第1カセット23に一度おさまり次いで矢印b,c,d,e,f,g,h,i,j,k,m,n,o,pに順次沿って進み、脱付処理室中間収納室20の第2カセット22に戻る。そして再び矢印mによってロードロッカ室10内の最初のカセット位置に戻る。以上が従来装置の動きである。

第2図は本発明によるスペック装置の実施例を示す。本実施例においてもロードロッカ室10、中間収納室20の構造とそれらの内部における基体の搬送は前述の従来の場合と全く同じである。前処理室30をはさんで対称に2個のスペック室

50,51が、それぞれ仕切弁41,41を介して設けられている。そしていずれか一方のスペック室を使用することにより前述と同様の脱付処理ができる。即ち、矢印c,d,a,e,f,g,h,i,j,k,m,n,pに順次沿って基体を搬送することによりスペック室50を用いた処理を行うことができ、他方d',e',f',g',h',j',k',m'に順次沿って基体を搬送することにより、スペック室50'を用いた処理を行うことができる。また前処理室30のステージ26,27,29は基体の搬送との間の搬送に用い、ステージ28が加熱あるいはエッティング等の初期処理に用いられる。元に述べた如く、本装置を用いて脱付処理を行っている間に、仕切弁41を閉じたままスペック室50を大気開放して内部の雰囲気化、工具及びターゲット等の交換などに該する定期保守作業を行い、その後再び真空中に挿入して、スペック室50の保動計測時間が終了しスペック室50'に切換える時期が来るのを待つ。また予期せぬ事故でスペック室50を大気に開放せざるを得ぬような事態にな

ることなく、これでスペック室50'に切換えて生産を長時間中断することなく装置の修理ができる。

以上は本発明の具体的実施例をスペック装置によって説明したものであるが、本発明はスペック装置に限らず真空を用いる多くの薄膜処理装置に応用できる。既にドライエッティング装置、プラズマCVD装置、真空蒸着装置等はスペック装置と同様で薄膜処理中の真空の気が処理の性質に大きな影響を与える。そのため処理室の定期的保守点検の仕組みを含む運転するまでには板めて長時間を使っているが、本発明はこの空気時間をゼロにするものである。本発明の生産性向上への貢献は非常に大きく、工業上有利の発明ということが出来る。

#### 4. 図面の簡単な説明

第1図は、従来のスペック装置の構成を示す図。

第2図は、本発明のスペック装置にかける実施例の構成を示す。

10…ロードロッカ室 20…中間収納室  
30…前処理室 50…スペック室

60…スペック室 70…スペック室  
13,24,25,26,27,28,29,42,43,  
44,45,46は基体を示す。

特許出願人 日電アネルバ株式会社

特開昭60-238479(5)

FIG. 1

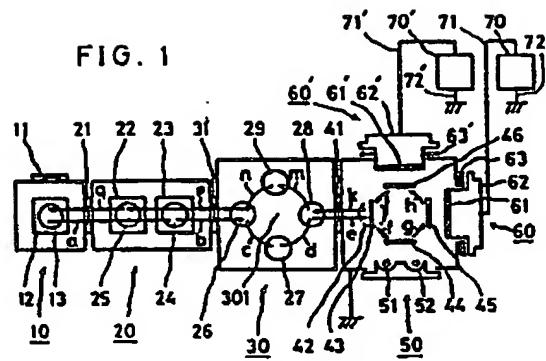
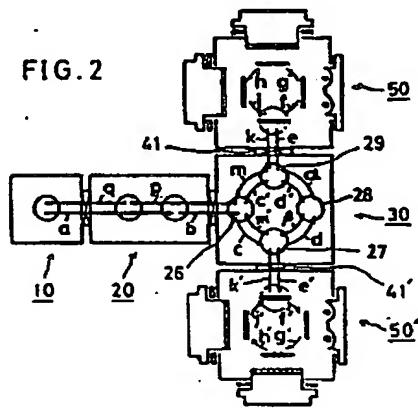


FIG. 2



Laid-open Number: 60-238479

Laid-open Date: November 27, 1985

Application Number: 59-83610

Application Date: May 10, 1984

Int. Class Number: C 23 C 14/56

Name of Applicant: ANELVA CORPORATION

#### SPECIFICATION

##### 1. Title of the Invention:

Vacuum Thin Film Processing Apparatus

##### 2. Claim:

A vacuum thin film processing apparatus, comprising:

a load and lock chamber for storing substrates which can be vacuumed;

processing chambers for implementing a filming process on said substrates in a vacuum; and

a pre-processing chamber disposed between said load and lock chamber and said processing chamber, having a mechanism for automatically transporting said substrates and capable of implementing a pre-processing of said filming process; and

characterized in that said processing apparatus has a plurality of said processing chambers and is constructed so that a transportation path of said substrates between said

load and lock chamber and said plurality of processing chambers can be selected so that the filming process may be implemented on said substrate in at least one processing chamber selected from said plurality of processing chambers.

3. Detailed Description of the Invention:

The present invention relates to a structure of a sputtering apparatus for automatically forming thin films sequentially on a large number of plate substrates having the same shape by sputtering, and more particularly to a structure of a sputtering apparatus which allows to shorten a downtime of the apparatus caused by the maintenance of the apparatus and to increase a rate of net production time in the whole apparatus operating time.

One exemplary field in which the present invention may be applied is a thin film fabricating process in a process for manufacturing integrated circuits. In that process, it is required, for example, to form a metallic thin film and an insulating thin film having a thickness of about  $1 \mu$  on a disc-shaped thin silicon wafer having a diameter of about 125 mm and a thickness of about 0.5 mm. Because the lower the partial pressure of impurity gas within a vacuum container, the better the electrical, mechanical and physical characteristics necessary for the thin films to be fabricated may be obtained in general, it is desirable to shorten a time

exposed to the air as much as possible in the processing chamber for fabricating thin films by sputtering. Also for the same purpose, it is necessary not to bring a material body which may cause impurity gas into the processing chamber. Therefore, it is desired to limit a material body which is brought into the processing chamber to what is just necessary for transporting wafers and ideally, an apparatus having a structure by which only wafers on which thin films are fabricated are brought into the processing chamber is desirable. Further, it is desirable to automatically transport wafers without being directly touched by operators as much as possible when they are handled in order to fabricate uniform thin films efficiently on a large volume of wafers. Further, it is necessary to coat the surface of the wafer only by the thin film having a predetermined thickness and it is not desirable to have fine dust mixed therein or to create pinholes or the like where no film is coated. Due to that, it is preferable to hold wafers vertically within the processing chamber so that no dust deposit on the surface of the wafers, even if dust is produced, during the fabrication of the film.

A vacuum system of the sputtering apparatus used for the purpose described above comprises, basically, a processing chamber for fabricating thin films on substrates and a load and lock chamber for inserting substrates before processing

from the air and for conveying the processed substrates to the air. Normally, the processing chamber is kept in a vacuum state in order to keep a partial pressure of impurity gas as low as possible and only the load and lock chamber is exposed to the air and is vacuumed every time when the substrates are brought in and out. A gate valve between the load and lock chamber and the processing chamber is opened only when the load and lock chamber is vacuumed to transport the substrates between each of the containers.

By the way, in considering a production process for processing an extremely large volume of wafers for a long period of time, it is impossible, from the common sense, to operate the sputtering apparatus for the filming process continuously for a long period of time. That is, the apparatus is always stopped by some reasons, causing a need to destroy the vacuum of the processing chamber. Though it is undesirable for the producer, a case when the function of the apparatus cannot be performed by some failure is one reason of the unavoidable stoppage of the apparatus. Although the probability of causing a failure could have been reduced to the degree which causes practically no problem by making various efforts to improve the reliability of the apparatus, it cannot be completely eliminated from the aspects of economy and others.

Rather, an apparatus having an adequate price is

operated with an adequate cost in general and the vacuum of the processing chamber is destroyed periodically to positively perform maintenance works. The maintenance works include a replacement of a wear old target material with new one, recovery of evacuation ability by refreshing a cryopump, removal of sputtered film adhered within the container, readjustment of a wafer transport mechanism, and the like. While the vacuum processing chamber is closed and is vacuumed again after the maintenance works, the partial pressure of the impurity gas in the processing chamber has to be lowered in order to obtain thin films having a certain quality as described before, so that preliminary operations such as full vacuuming, baking, pre-sputtering and the like have to be carried out taking a long time before entering the production. The rate of the net production time for fabricating thin films on the wafers and the operating time of the apparatus other than that, i.e. the total time of time during which the apparatus is stopped by the failure, time for restoring the apparatus, time of scheduled maintenance works planned in advance and time thereafter necessary for the preliminary operation before starting the production is influenced by various factors such as the structure of the apparatus and reliability of the parts used, propriety of operations and works and skill of the operators operating and maintaining the apparatus, degree of difficulty

of obtaining characteristics required for films to be fabricated and the like. However, the rate of the time for the maintenance and for the ensuing preliminary operations for re-starting the production in the whole time is considerably large in any sputtering apparatuses. For example, in the typical sputtering apparatus presently used, while the vacuum of the processing chamber is destroyed and the maintenance including the replacement of the target is carried out every time when 2,000 wafers are processed taking about 33 hours, it takes more than four hours, including the maintenance, before starting the next production. Another sputtering apparatus requires about 10 hours of maintenance and preliminary operations before the next production every time when 5,600 wafers are processed taking about 100 hours.

Accordingly, it is an object of the present invention to provide a sputtering apparatus which solves the aforementioned problems, i.e. to provide a novel apparatus which can increase the rate of the net time for fabricating thin films in the whole operation time of the sputtering apparatus.

The summary of the apparatus will be described. According to the present invention, a plurality of thin film processing chambers having the same function is provided within one vacuum thin film processing apparatus. During when the apparatus is normally operated, thin films are

processed in a first processing chamber among them and other processing chambers are not used for the processing. Then, in a stage when thin film processing works of predetermined planned time is finished and the processing in the first processing chamber is stopped to break the vacuum thereof to perform the maintenance work described above, the conveying path for sending substrates to be thin film processed is changed to a second processing chamber and processing is carried out in the second processing chamber. In parallel with the processing in the second processing chamber, the periodic maintenance work is done in the first processing chamber and following that, the preliminary operation for starting another processing is carried out. Because the time consumed for the periodic maintenance work and preliminary operation is generally shorter than the time during which the first and second processing chambers can bear the continuous work, the first processing chamber is ready to start processing again at the point when the time has come to stop processing in the second processing chamber to maintain the chamber. Accordingly, the processing of thin films may be carried out continuously by alternately using the first and second processing chambers having the same function. Further, even when an unexpected failure is caused and the processing chamber has to be repaired, this method allows to repair the failure while continuing the production by sending

substrates to be processed to another processing chamber not used till then.

While the case when two processing chambers of the first and second chambers are alternately used has been described in the above explanation, there is practically no trouble in the continuous production by providing two processing chambers having the same function in general. However, the risk of interruption of the production may be lowered to the minimum in cases when the time consumed for the periodic maintenance and preliminary operation is relatively long or when a frequency of causing unexpected failures is high, by providing more than three processing chambers having the same function. However, it increases a volume of the occupied space as a whole apparatus and its price. In considering those points together, an apparatus provided with two processing chambers having the same function and which allows the continuous production is practically preferable. However, the present invention will not particularly limit the number of processing chambers having the same function.

The present invention will be concretely explained hereinbelow with reference to the drawings.

Fig. 1 is a diagram illustrating one example of a prior art sputtering apparatus. In the figure, the apparatus comprises a load and lock chamber 10, an intermediate storage chamber 20, a pre-processing chamber 30 and a sputtering

chamber 50, and gage valves 21, 31 and 41 are provided between each chamber. Each chamber is vacuumed independently by a pump not shown and is kept in the vacuum state. A new substrate is stored in a cassette 12 and is inserted to the load and lock chamber 10 from an inlet 11 of the load and lock chamber 10 and is taken out from there after finishing the filming process by sputtering. Provided within the intermediate storage chamber 20 are two cassettes 22 and 23. The intermediate storage chamber 20 performs roles of preventing the quality of the vacuum in the pre-processing chamber 30 and the sputtering chamber 50 from dropping due to the opening/closing of the load and lock chamber 10 and of conveying non-processed substrates and processed substrates without sacrificing the capacity of the whole apparatus per unit time, and the detailed explanation concerning to the structure and role thereof are given in Japanese Patent Application Nos. 55-169057 and 55-137802. The pre-processing chamber 30 plays a role of implementing preliminary processes such as heating of the substrates and sputter-etching on the pre-stage of the fabrication of the films by sputtering. The substrate is placed on either of four stages 26, 27, 28 and 29. Among them, the stage 27 is used for heating or sputter-etching and the stage 29 is used for cooling, or the like. While the substrates are conveyed through and in the load and lock chamber 10, the intermediate storage chamber 20

and the pre-processing chamber 30 by a linear movement using a belt and a rotary movement centering on an adequate axis, the explanation thereof is given in detail in Japanese Patent Application Nos. 55-151815 and 56-35743.

Within the sputtering chamber 50, a substrate 42 (shown by dashed line) in a horizontal state is rotated by 90° to be held in an almost vertical state as shown by the reference numeral 43 and then is rotated as it is by step of about 90° around a vertical axis 301 which is located almost at the center of the pre-processing chamber 30. A substrate 44 is heated by heating lumps 51 and 52 in a second state in the pre-processing chamber 30 and a filming process is implemented on a substrate 45 in a third stage. Similarly, another filming process is implemented on a substrate 46 in a fourth stage. Sputtering electrodes 60 and 60' are provided at the positions facing to the substrates in the third and fourth stage. The sputtering electrode comprises a target 61 and a cathode body 62 and is mounted on the wall of a vacuum container through an intermediary of an insulator 63. A minus high voltage is applied to the cathode body 62 by a sputtering power supply 70 via feed lines 71 and 72 (to earth potential). However, the wall of the metallic vacuum container is grounded by an earth source 81 and is kept in the earth potential. When a gas such as argon is supplied to the sputtering chamber 50 via a gas introducing system not

shown, a low voltage gas discharge is caused near the cathode and positive ions hit the target 61 and others, forming thin films by sputtering. In the whole apparatus, the substrate 13 stored in the cassette 12 is stored once in the first cassette in the intermediate storage chamber through a path shown by an arrow a and then is advanced sequentially along arrows b, c, d, e, f, g, h, j, k, m, n and p and is returned to the second cassette 22 in the intermediate storage chamber 20 after the filming process. Then, it is returned again to the original cassette position within the load and lock chamber 10 along an arrow q. This is how the prior art apparatus is operated.

Fig. 2 is a diagram illustrating a preferred embodiment of a sputtering apparatus of the present invention. In the present embodiment, the structure and the conveyance of substrates within the load and lock chamber 10 and the intermediate storage chamber 20 are the totally same with the prior art example described above. However, two sputtering chambers 50 and 51' are provided symmetrically interposing the pre-processing chamber 30 therebetween through the intermediary of gate valves 41 and 41', respectively. Then, the same filming process with that described above may be performed by employing either one sputtering chamber. That is, a process employing the sputtering chamber 50 may be performed by conveying substrates sequentially along arrows

c, d, α, e, f, g, h, j, k and m and another process employing the sputtering chamber 50' may be performed by conveying substrates sequentially along arrows c', d', β, e', f' g', h', j', k' and m'. It should be noted that the stages 26, 27 and 29 in the pre-processing chamber 30 are used to convey the substrates between the neighboring chambers and the stage 28 is used for pre-processing such as heating and etching. As described before, while the filming process is performed using this apparatus, periodic maintenance works such as cleaning of the inside and replacement of jigs and targets is carried out by opening the sputtering chamber 50' to the air while closing the gate valve 41' and after that, the chamber is vacuumed again to be ready for the time when the planned operation time of the sputtering chamber 50 ends and the chamber is switched to the sputtering chamber 50'. Further, even when a situation occurs which compels to open the sputtering chamber 50 to the air due to an unexpected failure, the apparatus may be repaired without interrupting the production for a long time by switching to the sputtering chamber 50'.

While the concrete embodiment of the present invention has been explained above, the present embodiment may be applied not only to the sputtering apparatus but also to many thin film processing apparatuses using vacuum. In particular, a dry etching apparatus, plasma CVD apparatus,

vacuum deposition apparatus and the like are similar to the sputtering apparatus and the quality of vacuum during filming process influences significantly to the performance of the processing. Due to that, although it is taking a quite long time before operating the apparatus after the periodic maintenance and inspection of the processing chamber, the present invention eliminate this idle time to zero. The contribution of the present invention to the improvement of the productivity is very large and it can be said that the present invention is an useful invention industrially.

4. Brief Description of the Drawings:

Fig. 1 is a diagram illustrating a structure of a prior art sputtering apparatus; and

Fig. 2 is a diagram illustrating a structure of a preferred embodiment of a sputtering apparatus of the present invention.

In the drawings, the reference numeral (10) denotes a load and lock chamber, (20) an intermediate storage chamber, (30) a pre-processing chamber, (50) a sputtering chamber, (60) a sputtering electrode, (70) a sputtering power supply, (13, 24, 25, 26, 27, 28, 29, 42, 43, 44, 45 and 46) substrates.

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